WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2005HI103B

Title: Integrated management of multiple aquifers with subsurface flows and inter-district water transport

Project Type: Research

Focus Categories: Economics, Groundwater

Keywords: Integrated management, multiple aquifers, subsurface flows, inter-district transport

Start Date: 03/01/2005

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Federal Funds: $19,713

Non-Federal Matching Funds: $37,442

Congressional District: HI 1st

Principal Investigator:
James A. Roumasset

Abstract

Our previous USGS-funded research has provided separate estimates of efficient water allocation over space and time for the Honolulu water district (Pitafi and Roumasset 2004) and intertemporal allocation for the Pearl Harbor aquifer (Kaiser et. al. 2003). We have also shown how the efficient solutions can be implemented with marginal cost pricing and illustrated how intramarginal blocks of water can be provided at no charge in order to render efficient pricing win-win and politically feasible.

The objective of the proposed research is to take the logical next step of estimating efficient water allocation and pricing for a system of aquifers, including the Honolulu, Pearl Harbor, Wahiawa-Schofield, and Waialua-Kawailoa groundwater basins. In doing so, we will take account of both subterranean flows between aquifers and the possibility of transporting water across districts.

Groundwater aquifers on Oahu are interconnected through semi-permeable barriers. Water flows naturally across adjacent aquifers depending, among other things, on the head level gradient between aquifers. Previous studies have shown that efficient

intertemporal allocation of groundwater may result in head level drawdown in some aquifers and head level buildup in others. This will result in changes in subsurface flows between aquifers, which have not previously been taken into account. In addition to these natural transfers, consumers located in one aquifer area can be supplied from water extracted and transported from another aquifer if this results in cost savings over local extraction. Incorporating such interdistrict transport is necessary for a fully efficient allocation framework.

Furthermore, the usual assumption of sharp interface between freshwater and underlying saltwater results in tight constraints on head level in order to prevent extraction of saltwater. This can be relaxed by assuming that salt concentration gradually increases within a zone of transition. Brackish water extracted from a well can then be mixed with freshwater from other wells to bring it to the drinking water standards of the State. This model provides an intermediate case between the case where water can be extracted until the sharp interface is reached and the strict constraint wherein the slightest increase in salt concentration is not allowed.

References:

Kaiser, Brooks A., Wetinee Matsathit, Basharat A. Pitafi, and James A. Roumasset, “Efficient Water Allocation with Win-Win Conservation Surcharges: The Case of the Ko'olau Watershed,” University of Hawaii Water Resources Research Center Working Paper, November 2003.

Pitafi, Basharat A. and James A. Roumasset, “Pareto-Improving Water Management over Space and Time,” paper presented at the Annual Meeting of the American Agricultural Economics Association, Denver, Colorado, August 1-4, 2004.